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First report of *Pterinotrematoides mexicanum* Caballero & Bravo-Hollis, 1955 (Monogenea, Macrovalvitrematidae) in *Micropogonias furnieri* (Desmarest, 1823) (Perciformes, Sciaenidae) from the coastal zone of the state of Rio Grande do Sul, Brazil

Moisés Gallas[1*], **Eliane Fraga da Silveira**[1] and **Eduardo Périco**[2]

1 Universidade Luterana do Brasil, Laboratório de Zoologia de Invertebrados, Museu de Ciências Naturais, Avenida Farroupilha, 8001, CEP 92425-900, Canoas, RS, Brazil
2 Centro Universitário UNIVATES, Laboratório de Ecologia, Museu de Ciências Naturais, Rua Avelino Tallini, CEP 95900-000, Lajeado, RS, Brazil
* Corresponding author: E-mail: mgallas88@gmail.com

Abstract: In South America, *Pterinotrematoides mexicanum* Caballero & Bravo-Hollis, 1955 has been reported in the state of Rio de Janeiro, Brazil, and in Argentina parasitizing *Micropogonias furnieri* (Desmarest, 1823). In this paper, the first record of *P. mexicanum* in the same host from the coastal zone of the state of Rio Grande do Sul, Brazil is presented, filling a gap of occurrence of *P. mexicanum*. The morphology of *P. mexicanum* is redescribed and compared with that of *Neopterinotrematoides avaginata* Suriano, 1975.

Key words: monogeneans, Whitemouth Croaker, helminth fauna, taxonomy, Neotropical Region

Yamaguti (1963) proposed the family Macrovalvitrematidae to group *Macrovalvitrema* Caballero & Bravo Hollis, 1955, *Hargisia* Yamaguti, 1963, *Macrovalvitrematoides* Yamaguti, 1963, *Pseudotagia* Yamaguti, 1963, and *Pterinotrematoides* Caballero & Bravo-Hollis, 1955. Subsequently, Bravo-Hollis (1982) proposed two macrovalvitrematid subfamilies, Macrovalvitrematinae Yamaguti, 1963 and Pterinotrematoidinae Bravo-Hollis, 1982, which includes the genera *Hargisia*, *Neopterinotrematoides* Suriano, 1975, *Nicolasia* Suriano, 1975, *Pseudohargisia* Payne, 1987 and *Pterinotrematoides* (Bravo-Hollis 1982; Payne 1987).

In Mexico, *Pterinotrematoides mexicanum* Caballero & Bravo-Hollis, 1955 has been observed parasitizing the gills of *Micropogon ectenes* (Jordan & Gilbert, 1882) (Caballero and Bravo-Hollis 1955). In South America, *P. mexicanum* was been found parasitizing *Micropogon* sp. in Peru (Tantaleán et al. 1985), *Archosargus rhomboidalis* (Linnaeus, 1758) in Venezuela (Fuentes-Zambrano et al. 2009), *Micropogon opercularis* (= *Micropogonias furnieri* (Desmarest, 1823)) in Argentina (Suriano 1966) and *M. furnieri* in Brazil (Kohn et al. 1989; Alves and Luque 2000, 2001a, b; Fernandes et al. 2009).

Until now, the only monogenean species reported in *M. furnieri* from the state of Rio Grande do Sul were *Neomacrovalvitrema argentinensis* Suriano, 1975, and *Neopterinotrematoides avaginata* Suriano, 1975 (Velloso and Pereira Jr. 2010). This is the first report of *P. mexicanum* parasitizing the Whitemouth croaker, *M. furnieri*, from the coastal zone of the state of Rio Grande do Sul, Brazil.

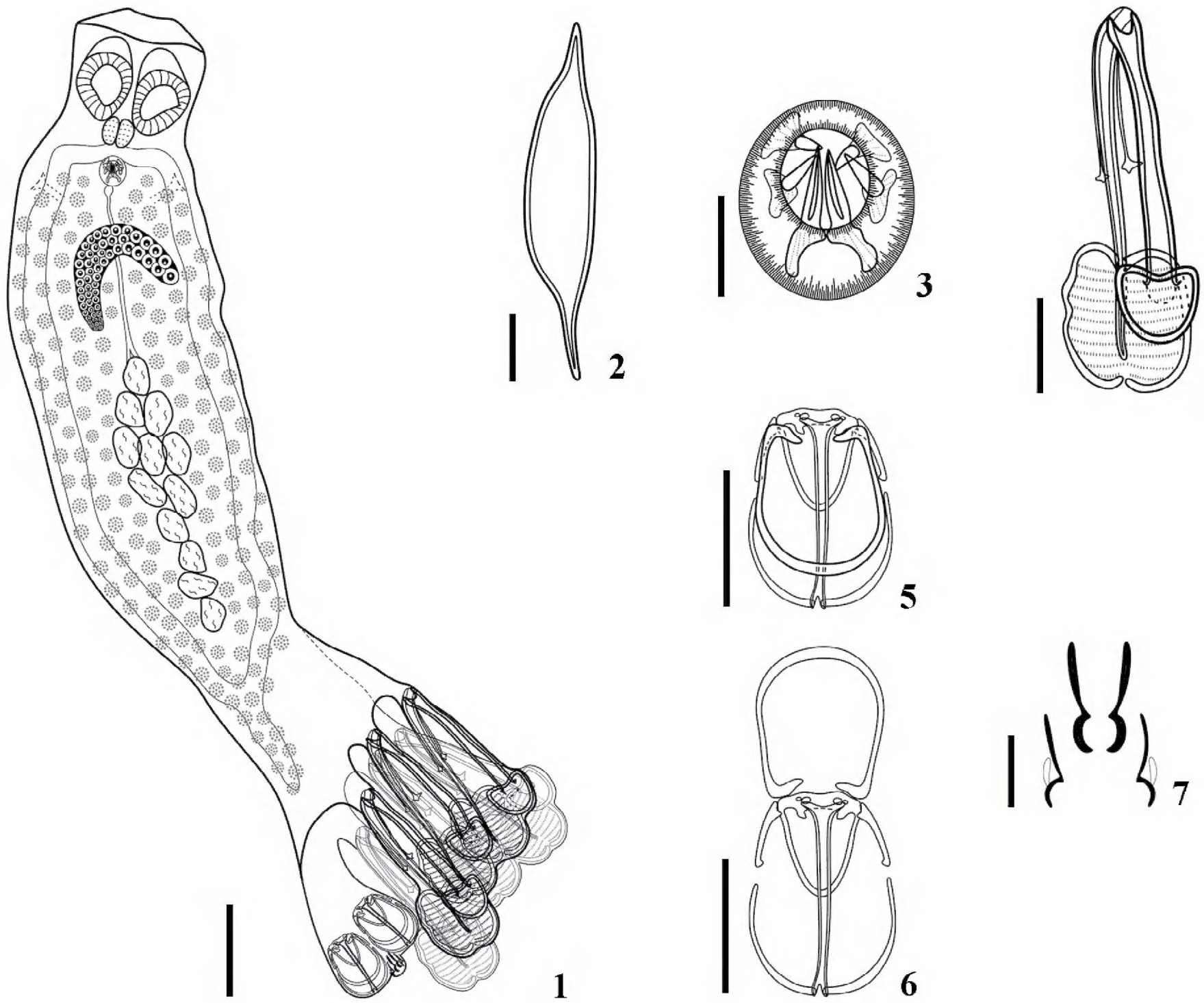
Specimens of *M. furnieri* (n = 3) were obtained from professional fisherman in July and August 2014 in the municipality of Rio Grande (32°11′06″ S, 052°06′32″ W), and from public market in Porto Alegre, in the State of Rio Grande do Sul, Brazil. Gills were placed in a 1:4000 formalin solution and shaken at least 50 times (Amato 1994). The monogeneans found in the samples were fixed in 5% formalin, stained with Semichon's carmine and mounted in Faure's medium or stained and mounted according to the procedures described by Gallas et al. (2014).

All measurements are given in micrometers (μm), unless otherwise indicated, and represent the range followed by the mean ± standard deviation, and sample size (in parenthesis). Ecological terminology follows Bush et al. (1997). The genus and species determinations of the monogeneans were based on Yamaguti (1963) and Caballero and Bravo-Hollis (1955), respectively. The line drawings were prepared using a drawtube and the photomicrographs were taken with a camera Sony DSC-W55 attached to the microscope. Representative specimens of the helminth were deposited in the

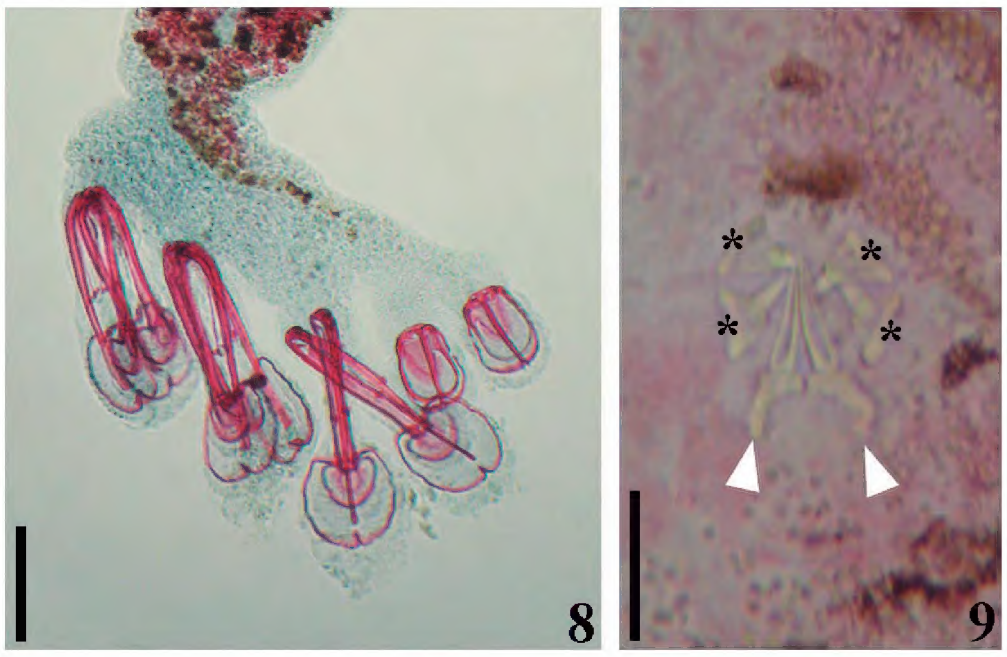
'Coleção Helmintológica' of the 'Museu de Ciências Naturais da ULBRA' (CHMU), Canoas, RS, Brazil.

Pterinotrematoides mexicanum Caballero & Bravo-Hollis, 1955
Figures 1–9.

This description is based on 12 specimens. Monogenea, Macrovalvitrematidae. Body 1.01–2.78 mm (1.49 ± 0.48 mm; *n* = 10) long, 0.17–0.25 mm (0.21 ± 0.03 mm; *n* = 10) wide. Anterior cephalic disc 92–147 (112 ± 17.22; *n* = 10) long, 74–194 (135 ± 37.61; *n* = 10) wide, with two oral suckers, 65–120 (82 ± 16.21; *n* = 10) long, 37–92 (65 ± 16.49; *n* = 10) wide. Pharynx 26–54 (43 ± 9.2; *n* = 10) long, 26–59 (40 ± 10.37; *n* = 10) wide. Cecal bifurcation anterior to the genital pore, caeca without branches, united posteriorly, in the peduncle of haptor. Haptor 286–562 (397 ± 78.72; *n* = 10) long, 157–323 (216 ± 43.87; *n* = 10) wide, symmetric, with eight clamps: six in individual peduncles (ventral clamps) and two in a common peduncle (dorsal clamps). Each ventral clamp formed by two valves, one ventral and one dorsal. Each ventral valve, 35–71 (42 ± 10.17; *n* = 10) long, 38–87 (526 ± 13.74; *n* = 10) wide, formed by an elongated midsclerite, 123–210 (166 ± 24.57; *n* = 10) long, ending in the middle of the valve where the two rami are fused. Each dorsal valve, 64–92 (79 ± 10.4; *n* = 10) long, 52–123 (75 ± 21.03; *n* = 10) wide, formed by an elongated midsclerite, 165–262 (200 ± 31.71; *n* = 10) long, ending next to the distal border of the valve; two contiguous lateral sclerites which terminate in two hooks adjacent to the midsclerite in the proximal border of the valve; and by 9–14 transversal rows of spines along the whole of the valve. In the midsclerite, two short hooks are located on the outer surface of the valve. Each dorsal clamp, 59–83 (75 ± 6.33; *n* = 10) long, 42–64 (53 ± 5.78; *n* = 10) wide, is formed by a contiguous anterolateral sclerite, 52–71 (62 ± 6.26; *n* = 10) long; a transversal sclerite with an extension towards to the distal border of the clamp, 33–49 (42 ± 5.03; *n* = 9) long; a midsclerite articulated to transversal sclerite and to posterior portion of the posterolateral sclerite, 59–78 (72 ± 5.49; *n* = 10) long; and posterolateral sclerites divided, anterior portion with proximal end articulated to transversal sclerite and distal end pointed internally, 21–33 (29 ± 3.87; *n* = 10)



Figures 1–7. Incomplete diagrams of *Pterinotrematoides mexicanum* Caballero & Bravo-Hollis, 1955. (**1**) Composite of entire specimen. Scale bar = 100 µm; (**2**) Egg. Scale bar = 50 µm; (**3**) Detail of the genital atrium. Scale bar = 20 µm; (**4**) Detail of the ventral clamp. Scale bar = 50 µm; (**5**) Detail of the dorsal clamp. Scale bar = 50 µm; (**6**) Detail of the dorsal clamp, open. Scale bar = 50 µm; (**7**) Detail of the hooks of the larval haptor. Scale bar = 15 µm.



Figures 8 and 9. Photomicrographs of *Pterinotrematoides mexicanum* Caballero & Bravo-Hollis, 1955. (**8**) Haptor. Scale bar = 100 µm; (**9**) Genital atrium with large hooks (white arrow heads) and small hooks (asterisks). Scale bar = 20 µm.

long, posterior portion 28–47 (39 ± 5.69; *n* = 10) long. Larval haptor, 31 and 35 long, 12 and 16 wide, with two pairs of hooks: the central pair, 21–26 (23 ± 1.95; *n* = 4) long, and the lateral pair, 21–24 (22 ± 1.11; *n* = 3) long. Genital atrium 28–38 (32 ± 3; *n* = 9) in diameter, 139-257 (183 ± 37.15; *n* = 10) from the anterior end, with three pairs of hooks, the largest, 21–28 (26 ± 2.19; *n* = 8) long, and the smallest, 12–14 (13 ± 1.14; *n* = 8) long. Testes 10–15 in number, post-ovarian, 38–52 (43 ± 4.95; *n* = 9) long, 26–45 (32 ± 5.11; *n* = 9) wide. Vas deferens narrow, forming an ejaculatory bulb close to the genital atrium. Two vaginae with laterodorsal pores, posterior to the genital atrium. Ovary pre-testicular, inverted U-shaped, 118–205 (161 ± 31.54; *n* = 6) long, 21–26 (23 ± 1.62; *n* = 6) wide. Oviduct and genito-intestinal duct not observed. Vitellaria from genital atrium level to anterior part of the haptor. Egg 215 long, 52 wide (*n* = 1), with filaments at both poles.

Taxonomic summary:

Host: *Micropogonias furnieri* (Desmarest, 1823).

Locality: Rio Grande (32°11′06″ S, 052°06′32″ W), state of Rio Grande do Sul, Brazil.

Site of infestation: gills.

Mean intensity of infestation: 10.67 helminths/host (all hosts were parasitized).

Amplitude of intensity of infestation: 7 to 17 helminths.

Voucher specimen of helminth deposited: CHMU 200-1-1.

The specimens were identified as *P. mexicanum* due to the presence of a goblet-shaped anterior region, two oral suckers and a symmetric haptor with four pairs of clamps, divided into two groups: ventral (bivalved) and dorsal, which were guitar-shaped without equatorial sclerites (Caballero and Bravo-Hollis 1955; Yamaguti 1963).

The measurements of the specimens are similar to those found in literature, although some variation in body length was observed. Specimens collected parasitizing *Micropogon* sp. and *A. rhomboidalis* in the Pacific Ocean (Tantaleán *et al.* 1985; Fuentes-Zambrano et al. 2009), tend to be larger than those found in *M. furnieri* in the Atlantic Ocean (Caballero and Bravo-Hollis 1955; Suriano 1966; Kohn et al. 1989; present study).

Difference were also found in the number and morphometry of the hooks of the larval haptor, with two pairs of hooks being found in the present study—as in Tantaleán et al. (1985) and Fuentes-Zambrano et al. (2009)—in contrast with three pairs in the studies of Caballero and Bravo-Hollis (1955) and Kohn et al. (1989). The specimens examined by Caballero and Bravo-Hollis (1955) were smaller in size than those examined by Tantaleán et al. (1985) and in the present study. The differences found in the oncotaxy of the larval haptor may be related to one of two distinct processes. One would be the loss of one of the pairs of hooks (Tantaleán et al. 1985; Fuentes-Zambrano et al. 2009), while the other possibility would be the difficulty of visualizing one of the lateral pairs, which may have been mistaken for the lateral border of the haptor (Caballero and Bravo-Hollis 1955; Kohn et al. 1989). The difference in the length of the hooks may be related to a scaling error, given that the hook is considerably longer than the scale used (Caballero and Bravo-Hollis 1955).

Neopterinotrematoides avaginata appears to differ from *P. mexicanum* only by the absence of a vagina (Kohn et al. 1989), which may not be sufficient to consider this form to be a valid species, but Kohn et al. (1989) did not evaluate other structures, such as the shape of ovary or the ventral valve of the ventral clamp and the posterolateral sclerites of the dorsal clamp. Comparing the description of *N. avaginata* by Suriano (1975) with the specimens of *P. mexicanum* examined in the present study, other traits were identified which help differentiate the two species. In *P. mexicanum*, for example, the ovary is shaped like an inverted U, and restricted to the anterior third of the body, whereas in *N. avaginata* the ovary is shaped like an inverted J and reaches as far as the middle region of the body. In *P. mexicanum*, in addition, the ventral valve of the ventral clamp is longer than wider, whereas in *N. avaginata* it is wider than longer, and in *P. mexicanum*, the posterolateral sclerites of the dorsal clamps are divided into anterior and posterior portions, while in *N. avaginata*, the sclerites are laterally contiguous. As mentioned above, a systematic review of these genera is required, and this should be based on a comprehensive examination of holotype and paratype material.

On the Atlantic coast of South America, *P. mexicanum* has been reported in the state of Rio de Janeiro (Kohn et al. 1989; Alves and Luque, 2000, 2001a, b; Fernandes et al. 2009) and in Argentina (Suriano 1966). This is the first report of *P. mexicanum* from the coastal zone of the State of Rio Grande do Sul, Brazil, providing important new insights into the geographic distribution of the

species. The present study constitutes the first detailed description of the sclerotized structures of the species since its description.

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